Sorensen Company
615 North Railroad
Paxton, ILL 60957
Tel 217-379-2171

Sorensen

Instruction Manual for

DCR-T Series Option M9A IEEE488 Interface

MP MASTER
MA25440

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DCR-T M9A OPTION
GPIB OPERATION

Interface Functions

The following interface functions, defined by IEEE standard 488 are implemented:

SH1	(Source Handshake)
AH1	(Acceptor Handshake)
T6	(Talker)
L4	(Listener)
SR1	(Service Request)
PP1	(Parallel Poll)
RL1	(Remote Local)
DT1	(Device Trigger)
E1	(Open Collector Drivers)

Multi-line Control Functions

The Acceptor Handshake, Source Handshake, Listener, and Talker functions are implemented by the interface card and the controller and require no action by the user. The ADR indicator led turns on when the power supply is addressed to listen or talk. (The talker function includes serial poll)

Service Request

Service request is a uniline message asserted by the power supply at power on and for fault conditions. Seven power supply conditions are defined as faults. Enabling or disabling a condition from asserting service request does not affect the condition within the power supply, nor external status indicators.

Device Clear

The power supply will implement Device Clear regardless of whether the unit is in local or remote control. Device Clear is typically used to send all or selected devices to a known state with a single command. The power supply will be set to Initial Conditions after Device Clear.

Device Trigger

Device Trigger will enable the most recently programmed values whether the unit is in local or remote control. If the power supply is in local mode, the new values will be implemented when switched from local to remote control. Device Trigger is typically used to synchronize the operation of a number of addressed devices.

Serial Poll

In a serial poll, the controller polls each device. The power supply responds with a 8 bit status byte defined as follows:

Bit Position	Decimal Weight	Description	Reset By
0 (LSB)	1	Fault - set when any bit in fault register is set	FAULT? query
1	2	Not Used	
2	4	Not Used	
3	8	Not Used	
4	16	Ready - set when power supply is ready to accept commands	Power supply, during command processing period
5	32	Error - set when ERR bit asserted in status register	ERR? query
6	64	Request Service - set when power supply requests service	Serial Poll
7 (MSB)	128	Power On - set when unit initializes at power on	CLR or Device Clear

Parallel Poll

Parallel poll allows the controller to determine quickly which of a number of instruments on the buss requested service. The parallel poll response corresponds to bit #7 of the serial poll status byte. Parallel poll does not reset the service request. The power supply must be configured remotely to respond to a parallel poll with either a "1" or "0" on one of the DIO lines if the unit is requesting service.

Remote/Local

The remote/local function allows the power supply to operate in either local or remote (IEEE 488) control. The power supply may be switched from REM to LOC and back to REM using the remote switch on the rear panel without loss of the programmed values. The user can send Local Lockout to the power supply via the IEEE 488 bus to disable the remote switch on the rear panel. With Local Lockout, the controller determines if the unit operates in local or remote mode. This enable the controller to prevent anyone from returning the power supply to local control.

Address Selection

The GPIB primary address switches on the DCR-T 10KW are located behind the front panel and for the DCR-T 5KW on the rear panel. The GPIB address is set in binary, with A1 the least significant bit and A5 the most significant bit. Any address from 00 to 30 decimal is a valid GPIB address. The power supply address is the total value of switches selected. Setting switches to Address 31 will cause a self-test error.

DCR-T 5KW and 10KW Models:

Address Switch Detail

Switch #	Function	Open	Closed	
8	A5	0	16	Primary Address
7	A4	0	8	value is set by
6	A3	0	4	A1, A2, A3, A4 &
5	A2	0	2	A5
4	A1	0	1	
3	-	-	-	
2	PON SRQ	ON	OFF	
1	REMOTE	ON	OFF	

Note: On DCR-T 10KW Models, address switches are located behind front panel.

DCR-T 10KW Model Selection

Model Number	Switch Number 6	7	8	Jumper Number 6	
DCR 16-625T	C	C	C	O	
DCR 32-310T	O	C	C	O	O = OPEN = OFF
DCR 55-180T	C	O	C	O	
DCR 80-125T	O	O	C	O	C = CLOSED = ON
DCR 110-90T	C	C	O	O	
DCR 160-62T	O	C	O	O	
DCR 300-33T	C	O	O	O	
DCR 600-16T	O	O	O	O	

(Note: For information on the DCR-T 5KW model selection, contact the factory)

Power-On Service Request

The power supply will request service from the controller if the rear panel PON SRQ switch is set (on 10KW models switch is behind front panel) and the power supply is turned on or any time a momentary input power dropout causes the power supply to re-initialize. The power supply initializes at power on with the following programmed values:

Initial Conditions (Remote enabled)

Voltage	0 Volts	(VSET 0)
Current	0 Amps	(ISET 0)
Soft Voltage Limit	VMAX (see models)	(VMAX 30)
Soft Current Limit	IMAX (see models)	(IMAX 2)
OVP Trip Voltage	Model VMAX + 10%	(OVSET 33)
Delay	0.5 seconds	(DLYy 0.5S)
Foldback Protection	off	(FOLD OFF)
Output	on	(OUT ON)
Hold	off	(HOLD OFF)
Unmask	none	(UNMASK NONE)
Service Request Capability	off	(SRQ OFF)

Programming Specifications (25 ± 5 °C)

	Program Resolution	Program Accuracy	Readback Resolution	Readback Accuracy
Voltage	±0.05%	±0.2%	±0.05%	±1.0%
Current	±0.05%	±0.2%	±0.05%	±1.0%
OVP	±0.05%	±1.0%	-	-

Programming Syntax

Lower-case alpha characters in command string are treated as upper-case alpha characters.

Numbers can be sent with implicit or explicit decimal point or in scientific notation.

Example: Implicit - 475, 005, 2 (integers)
Explicit - 14.4, 0.075, 1.
Scientific - 144 E -1, -5 e 0, 23 E 2

Numeric data may contain an optional plus or minus sign on both the number itself and the exponent.

At least one digit must proceed E. Lower case e and upper case E are treated the same.

Numeric data may contain leading or embedded spaced between signs and digits, decimal point and E, digits and E, and E and sign.

Example: 1.58 E + same as 1.58E+2

Embedded spaces between digits or between digits and decimal point are not accepted.

Spaces are used in all commands containing only one parameter. Any number of consecutive spaces is treated as one space.

Example: OUT ON - correct
OUTON - wrong

Commas are used to separate parameters in MASK and UNMASK commands. Only one comma is allowed, and it may be preceded or followed by any number of spaces.

Example: MASK CV,OVP,FOLD
MASK CV, OVP, FOLD
MASK CV , OVP , FOLD

Terminators indicate the end of a command string, and inform the power supply to execute the command. The termination characters are the semicolon and line feed.

Line feed is sent by most controllers automatically with OUTPUT statements. If more than one command per line is sent, the commands must be separated by semicolons.

A terminator may be preceded or followed by spaces.

Example: ISET 2.0A;VSET 5V or
ISET 2.0A ; VSET 5V

The carriage return character by itself will be accepted without error in all cases where a terminator is expected.

Commands may also be terminated by asserting EOI on the GPIB concurrently with the last byte of the command.

Example: VMAX 5.25
E
O
I

All data sent by the power supply to the controller is terminated by a carriage return and a line feed character. EOI is asserted concurrently with linefeed.

Example: VOUT 5.250CRLF
EOI

Device Dependent Command Descriptions

VSET x
VSET xV
VSET xmV

Programs the output voltage in volts or millivolt. The programmed voltage is the actual output in CV mode or the voltage limit in CC mode.

Range x = 0 to Model VMAX
Initial value = 0 Volts

VSET?

Queries the voltage setting and returns the value to the GPIB when addressed to talk.

Response VSET ddd.ddd or
VSET -ddd.ddd

VOUT?

Measures the actual voltage output and returns the value to the GPIB when addressed to talk.

Response VOUT ddd.ddd

VMAX x
VMAXxV
VMAX xmV

Programs an upper soft limit on the voltage programming value that the power supply will accept. If the soft limit is exceeded, or it the soft limit value is lower than the present output values, the supply will ignore the command, turn on the ERROR led, and set the ERR bit in the status and serial poll registers.

Range x = 0 to Model VMAX
Initial = Model VMAX

VMAX?

Queries the soft voltage limit setting and returns the value to the GPIB when addressed to talk.

Response VMAX ddd.ddd

ISET x

Programs the output current in amps or milliamps. The programmed current is the actual output in CC mode or the current limit in CV mode.

Range x = 0 to Model IMAX, Initial = 0 Amps

ISET?	Queries the current setting and returns the value to the GPIB when addressed to talk. Response ISET ddd.ddd
IOUT?	Measure the actual current output and returns the value to the GPIB when addressed to talk. Response IOUT ddd.ddd
IMAX x IMAX xA IMAX xmA	Programs an upper soft limit on the current programming value that the power supply will accept. If the soft limit is exceeded, or if the soft limit value is lower than the present output values, the supply will ignore the command, turn on the ERROR led, and set the ERR bit in the status and serial poll registers. Range x = 0 to Model IMAX Initial = Model IMAX
IMAX?	Queries the soft current limit setting and returns the value to the GPIB when addressed to talk. Response IMAX ddd.ddd
OVSET x OVSET xV OVSET xmV	Programs the over voltage protection trip point in volts or millivolts. Range x = 0 to 110% * Model VMAX Initial = 110% * Model VMAX
OVSET?	Queries the OVP setting and returns the value to the GPIB when addressed to talk. Response OVSET ddd.ddd
DLY x DLY xS DLY xmS	Programs the delay time after a new output voltage or current is implemented (VSET, ISET), or RST, T, TRG, or OUT ON command is received. During delay time, the power supply disables CV, CC, and FOLD from generating faults. This command is useful to avoid nuisance foldback or service requests that may be generated by CV, CC, or FOLD should the power supply momentarily switch modes while implementing a new output. Delay may be used in these cases to avoid unnecessary service requests. Bits in the status and accumulated status registers continue to be set and are not affected by the delay command. Range x = 0 to 32 seconds, with 32mS resolution Initial = 0.5 seconds

DLY?	Queries the delay setting and returns the value to the GPIB when addressed to talk. Response DLY dd.ddd
OUT ON OUT 1 OUT OFF OUT 0	Enables or disables power supply output. The power supply will continue to implement new commands while output is disabled. Initial = OUT ON OUT ON is disabled while in Local Mode.
OUT?	Queries the output on/off setting and returns the value to the GPIB when addressed to talk. Response OUT 0 or OUT 1
FOLD CV FOLD 1 FOLD CC FOLD 2 FOLD OFF FOLD 0	Enables or disables foldback protection, which will disable the power supply when the output enters the fold condition. Example: FOLD CV means the power supply should operate in CC mode, and foldback protection will turn off the output if the supply switches to CV mode. Foldback protection is disabled during delay time. Initial = FOLD OFF
FOLD?	Queries the foldback setting and returns the value to the GPIB when addressed to talk. Response FOLD 0 or FOLD 1 or FOLD 2
HOLD ON HOLD 1 HOLD OFF HOLD 0	Holds voltage and current setting values for later implementation when ON or implements immediately upon receipt when OFF. Held values are implemented with T, TRG or device trigger interface command allowing synchronization of multiple GPIB instruments. Initial = HOLD OFF
HOLD?	Queries the hold setting and returns the value to the GPIB when addressed to talk. Response HOLD 0 or HOLD 1

T TRG	Implements voltage and current setting values that have been sent and held by the power supply. The power supply will operate with previous values until the trigger command is sent (see HOLD). The device trigger interface message performs the same function.
CLR	Initializes the power supply to power on state and resets the PON bit in the serial poll register. The device clear interface message performs the same function.
ERR?	Queries the error detected and returns the value to the GPIB when addressed to talk. When the power supply detects a programming error it sets the ERR bit in the status register, which can be unmasked to request service. Additionally, the remaining portion of the command line is discarded. The error value is valid only while the ERR led on the rear panel is lit. Error query or a new error free command clears the ERR bit in both the status register and the serial poll register. Response ERR x (see error codes)
ID?	Queries the power supply model number and firmware version and returns the value to the GPIB when addressed to talk. Response ID mmmmmmmmmm Version x.xxX Example: DCR 32-310T Version 1.05
STS?	Queries the contents of the power supply's 8-bit status register that reflects the present state of the unit. Each of the eight bits represents a separate condition. When the condition is true, the corresponding bit is 1. Bits remain set in the status register as long as the corresponding conditions are true. See the register table below for a description of each bit in the status register, and the bit weight for each condition. Response STS ddd Example: If bits for OTP(16), OVP(8) and CC(2) are set, the power supply would send 26 (16+8+2) for ddd.

STS, ASTS, MAST and FAULT register

Condition/ Mnemonics	ERR	FOLD	SD	*LOC (DCR-T) OTP	OV	-	CC	CV
Bit Position	7	6	5	4	3	2	1	0
Bit Weight	128	64	32	16	8	4	2	1

SET CONDITION

ERR	Remote programming error
FOLD	Foldback protection tripped
SD	AC contactor is de-energized (OFF)
*OTP	Over temperature protection tripped
OV	Over voltage protection tripped
-	Not used
CC	Constant current mode
CV	Constant voltage mode
*LOC	Local mode of operation

* Note: LOC Mode and OVP indication incorporates on same bit position selectable via jumper (JP1) on interface cord.

ASTS?

Queries the contents of the accumulated status register, which stores any bit that was entered in the status register since the accumulated status register was last read, regardless of whether the condition still exists. Reading the status register provides the controller only the state of the power supply at the time STS? was received. A condition that lasts only momentarily may not be observed even with frequent polling of the status register. To ensure that a temporary change can be noted by the controller, the power supply maintains an accumulated status register. The register table above describes this register as well as the status register. A bit in the register will be 1 if the corresponding bit in the status register has been 1 at any time since the register was last read.

Response ASTS ddd

UNMASK x
UNMASK Mnemonics

Enables selected conditions to set bits in the FAULT register. Conditions can be enabled either by sending a string of mnemonics or by sending the decimal equivalent of the total bit weight for all conditions enabled The mnemonics and the bit weights are the same in the status register. Mnemonics are separated from each other by commas, and may be sent in any order. A bit is set in the fault register when the corresponding bit in the status register changes from 0 to 1 and the corresponding bit in the mask register is 1. Whenever any bit is set in the fault register the FAU bit is set in the serial poll register.

Range x = 0 to 255
Mnemonics = CV, CC, OV, OT, SD FOLD, ERR, NONE, ALL
Initial = UNMASK NONE

MASK x

Disables selected conditions from setting bits in the FAULT register. Conditions can be disabled either by sending a string of mnemonics or by sending the decimal equivalent of the total bit weight for all conditions disabled. The mnemonics and the bit weights are the same as in the status register. Mnemonics are separated from each other by commas, and may be sent in any order.

Range x = 0-255
Mnemonics = CV, CC, OV, OT, SD, FOLD, ERR, NONE, ALL

Example: UNMASK ERR, CC (enables ERR and CC)
UNMASK OV (ERR< CC and OV enabled now)
UNMASK 1 (ERR, CC, OV and CV enabled now)
MASK ERR, CC (only CV and OV enabled now)
MASK 8 (only CV enabled)

Note: UNMASK NONE = MASK ALL
MASK NONE = UNMASK ALL

UNMASK?

Queries the mask register to determine which bits have been selected to set faults and returns the value to the GPIB when addressed to talk.

Response UNMASK ddd

FAULT?

Queries the fault register to determine which bits have been set and returns the value to the GPIB when addressed to talk. A bit in the fault register is set when the corresponding bit in the status register changes from inactive to active and the corresponding bit in the mask register is set. Bits in the fault register and the fault line are cleared only after the register is read by the FAULT? query.

Response FAULT ddd

SRQ OFF

Disables or enables the power supply's ability to request service from the controller for fault conditions. The service request function allows use of either polling or interrupt programming. With SRQ on, the SRQ line will be asserted true whenever the FAU bit in the serial poll register changes from 0 to 1. Therefore, the mask register in addition to specifying which conditions set the FAU bit, also determines which conditions can generate service requests. Use of the FAULT? query will tell the user which condition caused the service request (except for PON). SRQ remains disabled until the FAU bit in the serial poll register is cleared by a FAULT? query.

Initial = SRQ OFF

SRQ?

Queries the SRQ setting and returns the value to the GPIB when addressed to talk.

Response SRQ 0 or SRQ 1

Error Codes

Error Number	
0	No Errors
1	Unrecognized Character - A character like @, *, $ was received.
2	Improper Number - A numeric character was received but the characters were not a proper number. Example: + - 10.3 V
3	Unrecognized String - An invalid command was received. Example: MASKERR
4	Syntax Error - Incorrectly placed word, number, separator or terminator was received. Example: OFF SRQ, VOUT 6V, MASK, ERR
5	Number Out Of Range - A number received for he command was too large. Example: IMAX 999A, DLY35S
6	Attempt to Exceed Soft Limits - An attempt was made to program a voltage or current greater than the soft limit. Example: VMAX 500V ; VSET 550V
7	Improper Soft Limit - An attempt was made to program a soft limit less than the output value.
8	Data Requested Without A Query Being Sent - The controller requested data from the power supply without first sending a query command.
9	OVP set below output - An OVSET command was sent with a trip value lower than the output voltage.

Calibration

CALIBRATION COMPONENT	DCR-T	PARAMETER AFFECTED
VADJ	R51	Voltage Programming full scale level - Iterative with VOFF
VOFF	R28	Voltage Programming offset - Adjust at 5% of full scale output voltage for best linearity - Iterative with VADJ
IADJ	R47	Current Programming full scale level - Iterative with IOFF
IOFF	R27	Current Programming offset - Adjust at 5% of full scale output current for best linearity - Iterative with IADJ
VGAIN	R49	Voltage read-back full scale level - Iterative with VZERO
VZERO	R50	Voltage read-back offset - Adjust at 5% of full scale output voltage for best linearity - Iterative with VGAIN
IGAIN	R45	Current read-back full scale level - Iterative with IZERO
IZERO	R38	Current read-back offset - Adjust at 5% of full scale output current for best linearity - Iterative with IGAIN
OVPREF	R19	Overvoltage programming full scale level
OVPOFF	R23	Overvoltage programming offset

SERVICE NOTES

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Sorensen Company
615 N. Railroad Avenue
Paxton, IL 60957-1086

217-379-2171
FAX: 217-379-2000

MP MASTER
MA25440